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(54) **Method for sizing natural- or synthetic-stone elements, particularly ceramic tiles, and machine for carrying out the method**

Verfahren zum Formatieren von Natur- oder Kunststein-Elementen, insbesondere keramische Fliesen, und Maschine zum Anwenden dieses Verfahrens

Procédé pour mettre à dimension des éléments en pierre naturelle ou synthétique, en particulier de carreaux en céramique, et machine pour la mise en oeuvre du procédé

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(56) References cited:  
EP-A- 0 697 558 WO-A-96/11083  
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EP 0 865 870 B1

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of the other pair and the squaring. The reference numeral 20 designates the device for centering the elements being machined. The reference numeral 21 designates the device for presetting for squaring, which in each instance can act on the rear edge or on the front edge of said elements. The reference numeral 22 (figure 8) designates the first section of the sizing plant. The reference numeral 23 designates the second section, which optionally also comprises squaring; the reference numerals 24, 25 designate the two measurement and control sections with optional automatic feedback to perform the necessary corrections of the active position of the grinding wheel or wheels, advantageously on the last pair thereof which is part of the machines 1. The reference numerals 26 and 27 designate the device for optional correction after comparison between the read measurement and the reference measurement.

[0018] The sizing method is carried out as follows. Sizing of the first pair of sides of the element 5 being processed occurs in the first plant section 15, where the element 5, conveyed by the line 14, is centered in the device 20 for centering with respect to the longitudinal axis of said first section, after positioning the pairs of grinding wheels 4, which work dry and are rotationally actuated by the motors 1 and moved into position by the respective linear actuators 9 or 13, so that each one reaches the working front according to a preset program, determining the distance  $d$  from the front of the corresponding plant section. The various and subsequent pairs of grinding wheels 4 gradually reduce the width of the element 5 until one reaches the dimension that corresponds to the preset size, which is checked by the device 18, while said element 5 continues through the rotation station (the so-called carousel) and then enters the second plant section 17. Here the element 5 undergoes an additional centering operation which is simultaneous with, or subsequent to, a positioning step for squaring, which is performed one element at a time by sets of elements 5, with subsequent insertion between the pairs of grinding wheels 4 which are adapted to perform, where necessary, simultaneously with squaring, also the sizing of the other dimension of the second pair of sides of the element being processed. This is followed by dimensional checking of the second size and by geometric checking of squareness, by measuring the angle or by comparing the lengths of the diagonals.

[0019] As regards the machine, in execution of the method related to the compensation of the wear of the grinding wheels 4, compensation occurs mainly as follows. At preset time intervals, depending on the degree of precision of the size, on the workability characteristics of the element 5 and on the wear characteristics of the grinding wheel, the linear actuator backs off each grinding wheel 4 by an extent which is sufficient to clear the path related to the sensor 6 and then returns the grinding wheel to the working front, and so forth.

[0020] During the cycle for compensating the wear of

one pair of mutually opposite grinding wheels 4, or even of a single grinding wheel, the fraction of workload that is neutralized during backoff is assigned to the next pair of grinding wheels 4 or to the next grinding wheel, except for the last fraction, which can be assigned to the preceding grinding wheel or pair of grinding wheels.

[0021] According to a variation of the program, it is possible to assign control of the wear of the last grinding wheel or pair of grinding wheels to the section 18 for size control of the corresponding plant section. In this case, compensation of the wear of the grinding wheel or pair of grinding wheels 4 is actuated by reading the size of the element 5 being processed.

[0022] When each grinding wheel 4 reaches its wear limit, an adapted sensor, not shown, produces the back-off of said grinding wheel, the issuing of an adapted alarm and operational presetting for tool replacement. During replacement, the workload related to the grinding wheel is assigned to other grinding wheels, as in the case of wear compensation.

[0023] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

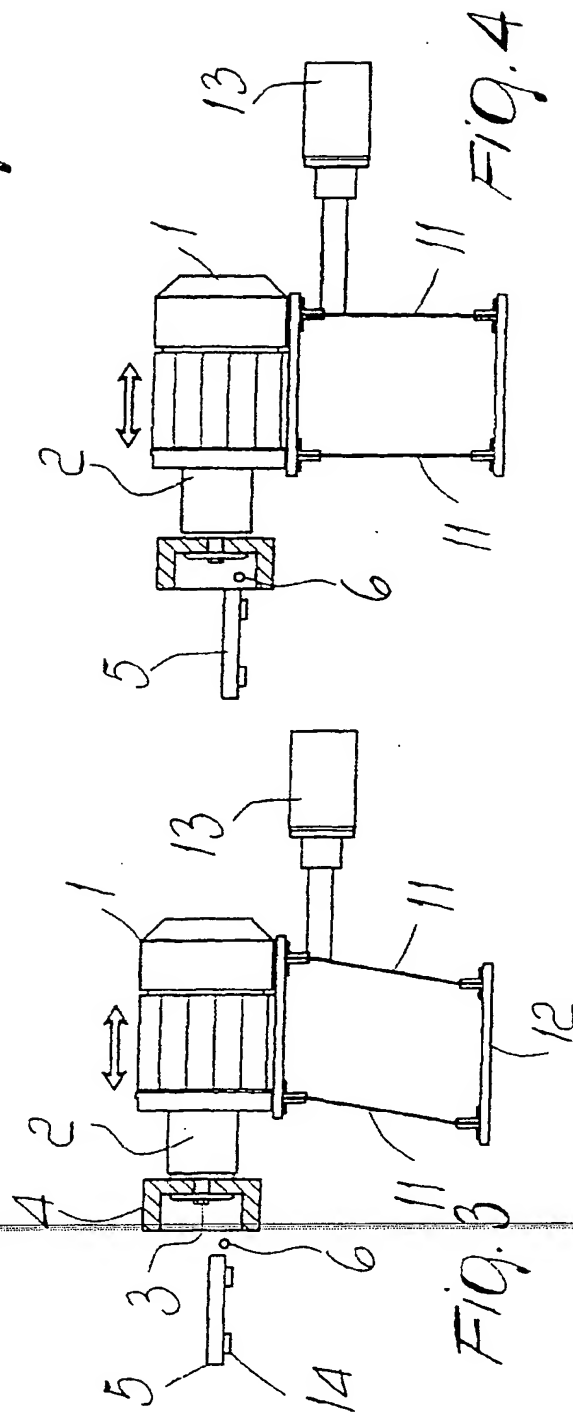
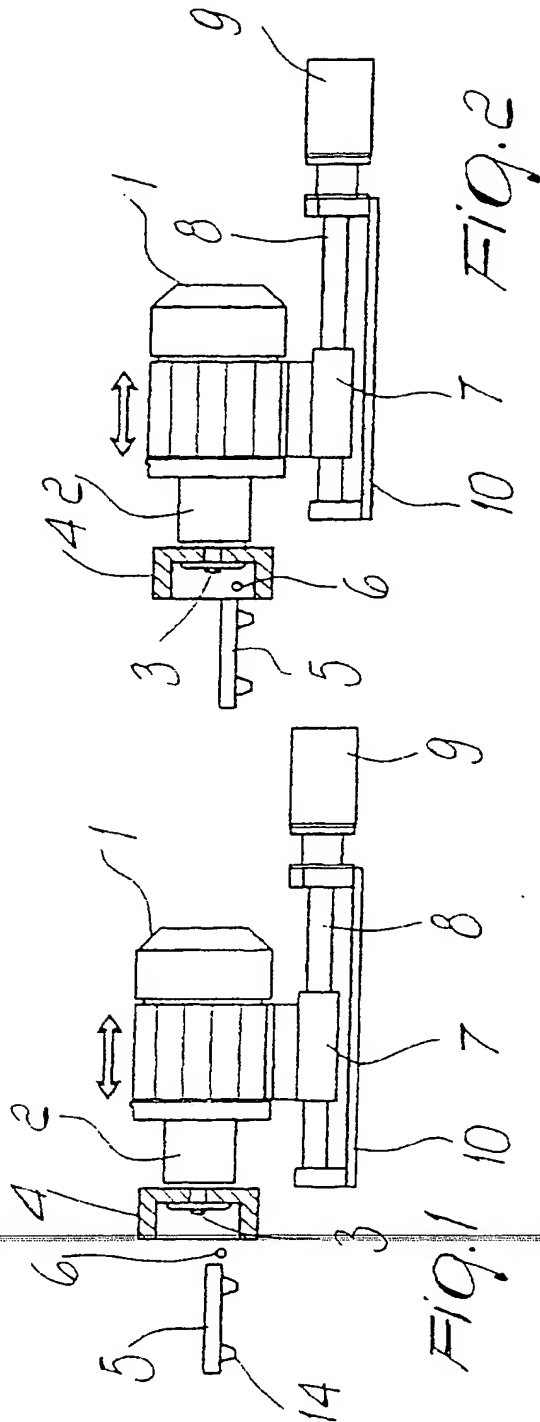
## 30 Claims

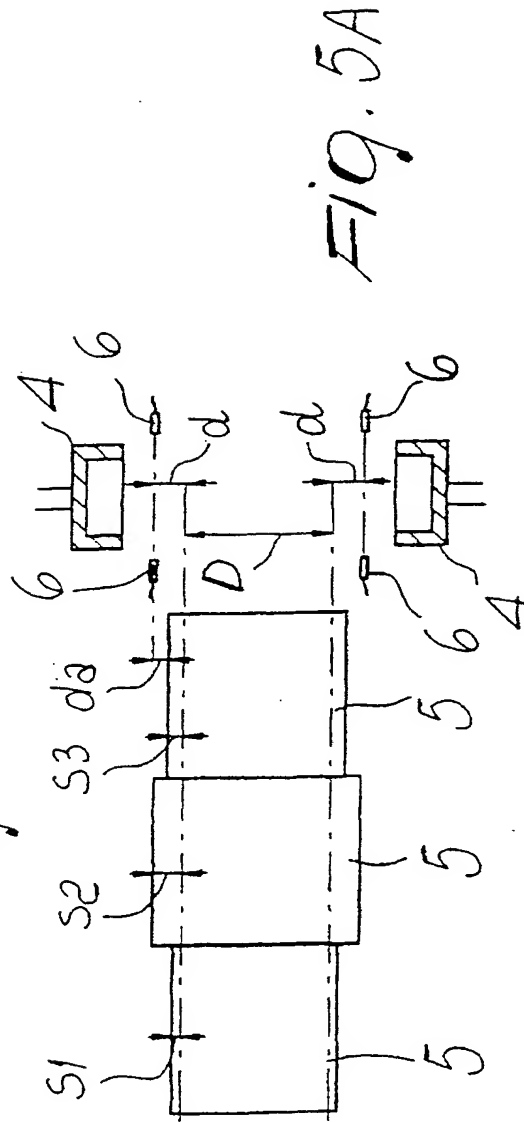
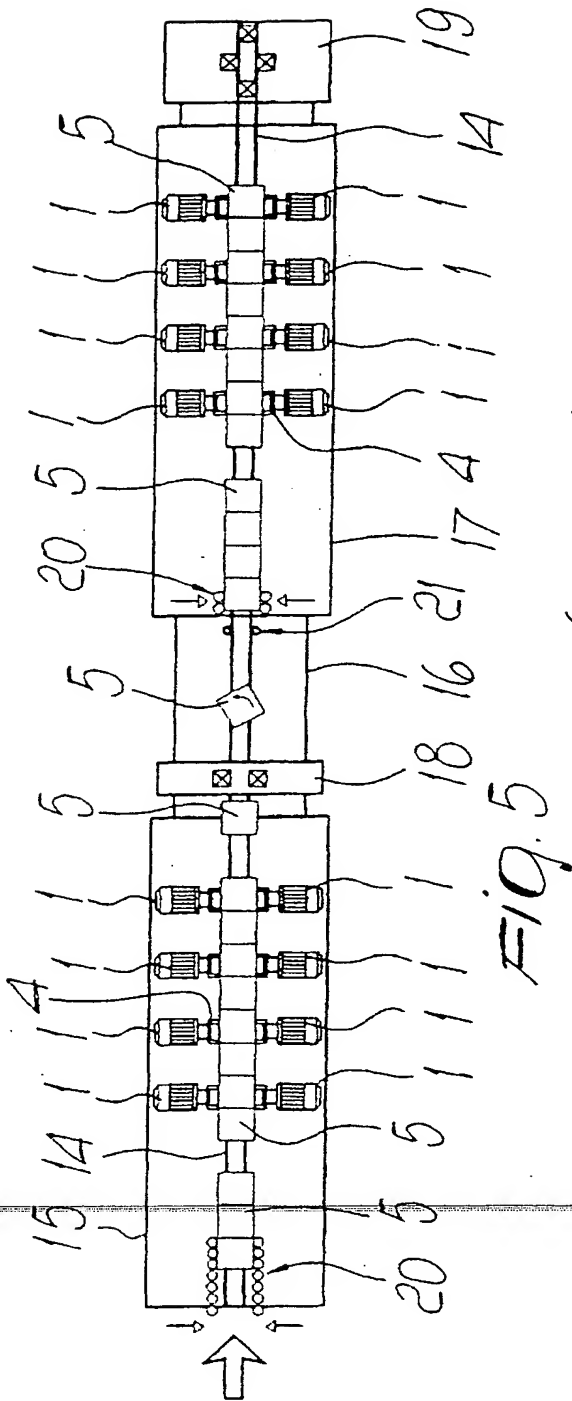
1. A method for sizing elements made of natural or synthetic stone, particularly ceramic tiles, which comprises the sizing and optional squaring, on both pairs of sides, of each natural- or synthetic-stone element (5) in two successive steps by means of an intermediate rotation through 90°, characterized in that sizing and optional squaring are achieved by means of a dry grinding process with continuous compensation of the wear of at least one grinding wheel (4).
2. The method according to claim 1, characterized in that a single size is used for the dimensions of each element (5).
3. The method according to claim 1, characterized in that it comprises the steps of:
  - sizing the element (5) in a first plant section, with subsequent removal of thickness of each edge of a pair of sides until finishing occurs by reaching the size;
  - checking the dimensions of the size by measurement and comparison;
  - rotating through 90°;
  - centering the element (5) in a second plant section and performing optional squaring;

- sizing the second pair of sides, where necessary;
  - geometrically checking the squaring, if performed;
  - checking the dimensions of the size of the second pair of sides; compensation of the wear of the at least one grinding wheel (4) being provided.
4. The method according to claim 1, **characterized in that** the wear of the at least one dry grinding wheel (4) is compensated according to time intervals which are preset according to the degree of precision of the element (5) being processed and to the wear characteristics of the grinding wheel.
5. The method according to claim 4, **characterized in that** wear compensation on the at least one grinding wheel (4) is performed after backing off from the working front in order to measure the value of the wear.
6. The method according to claim 5, **characterized in that** the grinding wheel backoff value between the working front and the front of said grinding wheel (4) is sufficient to clear the control path of an interposed control means.
7. The method according to claim 6, **characterized in that** the front of each grinding wheel (4) returns to the working front by moving by an extent which is equal to the extent of the backoff, including the value of the grinding thickness of the edge of the element (5), plus the wear that has occurred in the previous time interval.
8. The method according to claim 7, **characterized in that** the work load fraction of one pair of grinding wheels (4) is assigned to the next pair of grinding wheels (4).
9. The method according to claim 7, **characterized in that** the workload fraction that is neutralized in the backoff of one pair of grinding wheels (4) is assigned to the preceding pair of grinding wheels (4).
10. The method according to claim 3, **characterized in that** control of the compensation of the wear of the last pair of grinding wheels (4) of each one of said first and second plant sections is assigned to the size control section of the corresponding plant section: wear compensation being actuated by reading the size of the element being processed.
11. A machine for sizing elements made of natural or synthetic stone, particularly ceramic tiles, **characterised in that** it comprises at least one dry abrasive tool (4) which is made to rotate about its own axis and moves axially with respect to an element (5) being processed, first dry grinding means for first pair of sides of said element (5) being processed, second dry grinding means for second pair of sides of said element (5) being processed and continuous compensation means of the wear of at least one dry abrasive tool (4).
12. The machine according to claim 11, **characterized in that** at least one sensor (6) is interposed - with its own path - between said element (5) being processed and each one of said abrasive tools (4).
13. The machine according to claim 12, **characterized in that** said abrasive tool (4), rotationally actuated by a motor (1), is allowed to slide axially on at least one guide (8) by means of a linear actuator (9) which is supported on a frame (10).
14. The machine according to claim 13, **characterized in that** said abrasive tool (4) rotationally actuated by the motor (1) is allowed to slide axially by means of a linear actuator (13) which acts on a pair of oscillating elements (11).
15. A plant for treating natural or synthetic stone elements, particularly ceramic tiles, **characterized in that** it comprises a machine as defined in claim 11.
16. The plant according to claim 15, **characterized in that** it comprises elements (14) for conveying the natural- or synthetic-stone elements (5) which are sized and/or squared by dry abrasive tools (4), after passing through a centering device (20) and optionally a squaring device (21), with subsequent measurement and control sections with optional automatic feedback.
17. The plant according to claim 15, **characterized in that** it further comprises a device (26, 27) for size correction after comparison between the read measurement and the reference measurement, said device being present in each one of plant sections (15, 17) of said plant.

#### Patentansprüche

1. Verfahren zum maßgerechten Bearbeiten von Elementen aus Natur- oder Kunststein, insbesondere von keramischen Fliesen, welches die Bearbeitung auf Maß (Maßbearbeitung) und die optionale Bearbeitung auf rechte Winkel (Winkelbearbeitung) an beiden Seitenpaaren eines jeden Natur- oder Kunststeinelementes (5) in zwei aufeinanderfolgenden Schritten mittels einer Zwischendrehung um 90° umfaßt, dadurch gekennzeichnet, daß eine Maßbearbeitung und eine optionale Winkelbe-





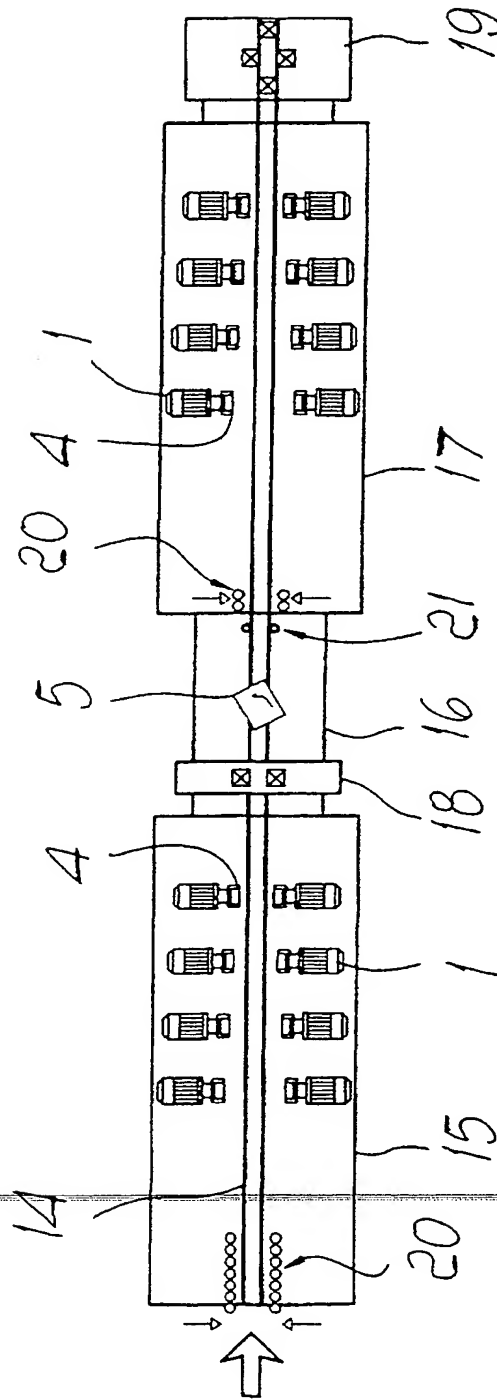
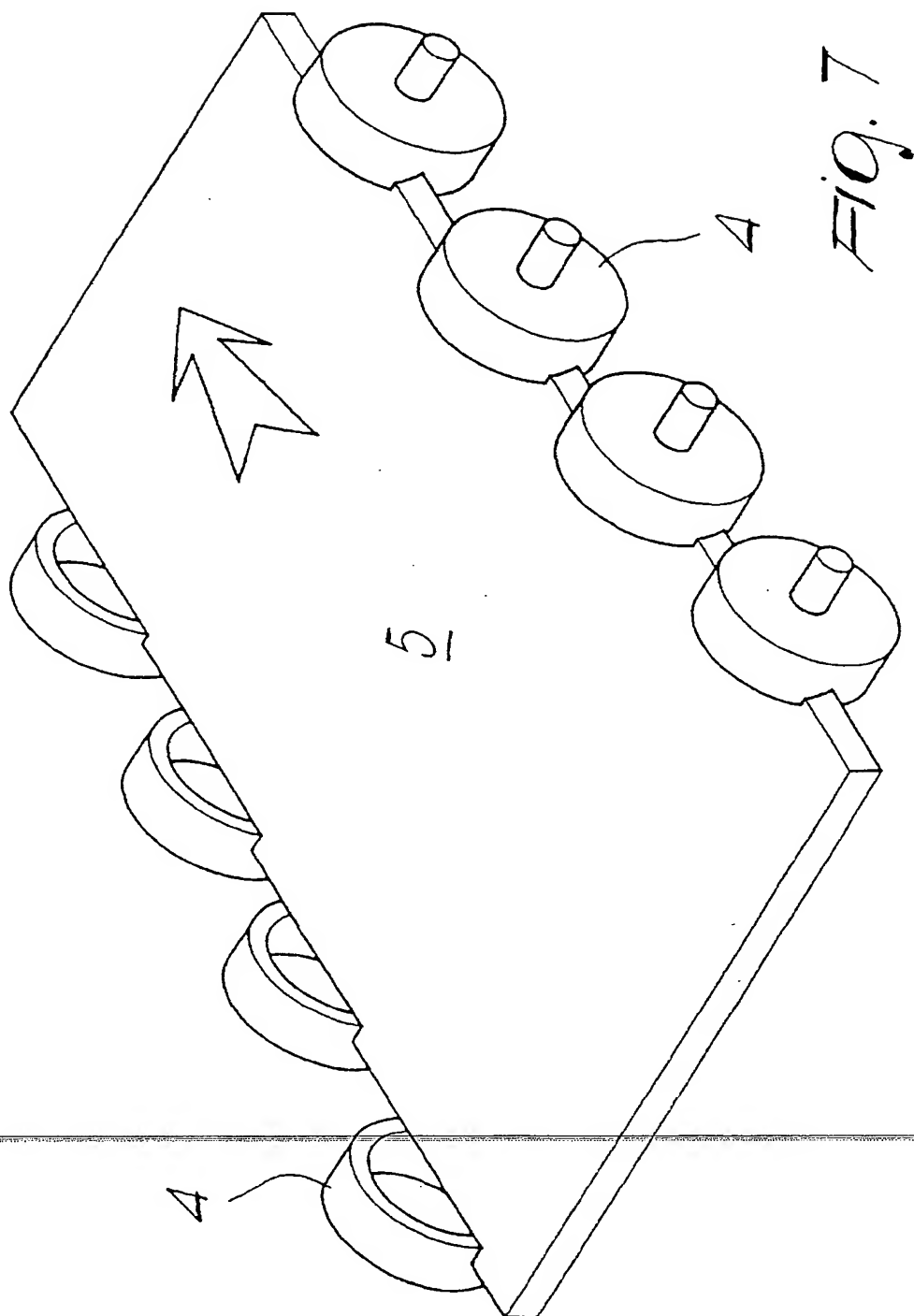


Fig. 6



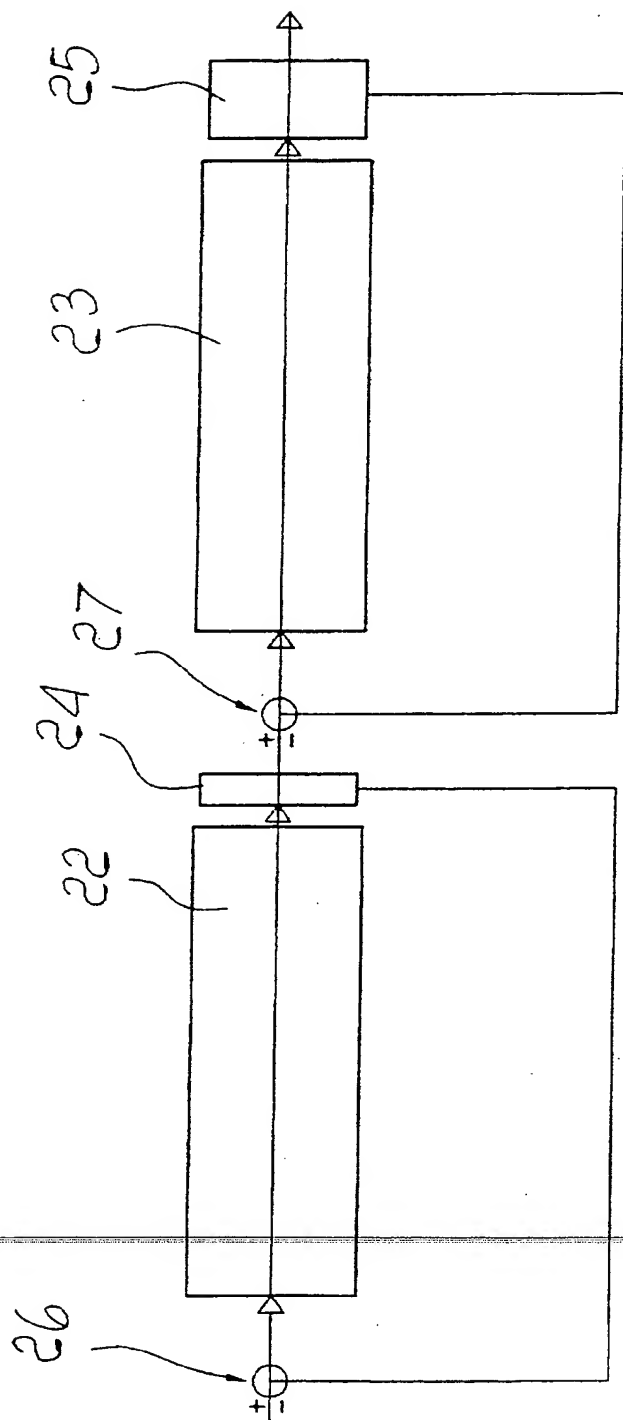


Fig. 8



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